

On the nature of Laser induced fluorescence spectrum of a bore-hole sample of coal

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Abstract

The present work describes the fluorescence spectrum of a sample of coal recovered from a depth of about 2km from the surface as a bore hole sample by Oil India Limited at Duliajan .The fluorescence spectrum was excited with the help of a 25mW green diode pumped solid state laser (532nm).The characteristic feature of the spectrum is a diffuse band in the region 6500-5900Å

Key words: Laser induced fluorescence, 25mW green diode, bore-hole sample of coal.

1. Introduction

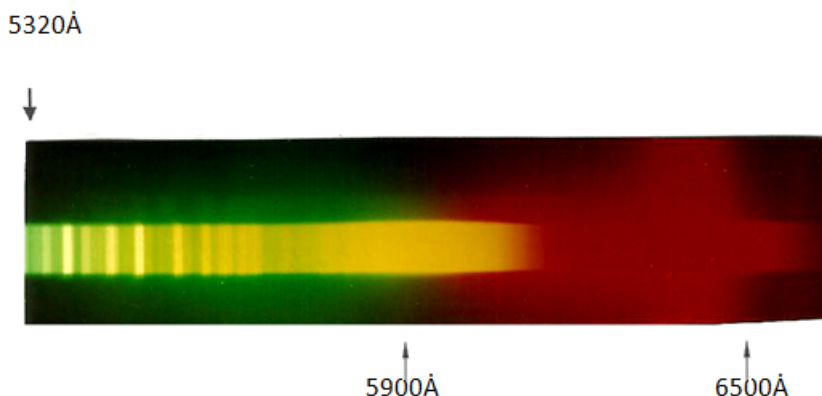
Coal is a carbonaceous sedimentary origin, which occurs as an intimate mixture of organic and inorganic materials. The product of partial decomposition of living materials laid down in sediments on death makes coal very complex and it continues to be a subject of investigation during past several decades due to several reasons .One prominent among them is presumably the evolution of the planet earth itself .The fluorescence is one of the well known technique to indentify oil bearing rocks procured from deep inside the earth. The use of laser radiation as an excitation source has a major impact on the study of complex materials such as coal (Meyers, 1982; Baruah *et.al*, 1995; Saikia *et.al*, 2007; Crelling and Bensley, 1995).A reasonably strong coherent monochromatic laser source can serve a variety of applications including sample induced fluorescence. Thus laser induced fluorescence (LIF) provides much as does Fourier transform infrared (FTIR) spectroscopy finger prints of different organic molecules which can be characterized by measuring fluorescence intensities. Many workers have described the microscopic fluorescence characteristics of various types of macerals. Liptinite maceral fluorescence more brightly than vitrinites, which in turn fluorescence more brightly than inertinites .The fluorescence intensity depends on the type of macerals, rank and the degree of biochemical degradation in the peat swamp.

The present work is primarily concerned with the first qualitative interpretation of the fluorescence spectrum exhibited by a sample of coal obtained as a bore hole sample from OIL India with the application of a green diode pump solid state laser .The present finding has shown prime importance in characterizing or finger printing the structure of coal.

2. Experimental

The coal sample was obtained as gift from OIL India, Duliajan. The sample is a bore hole sample procured by OIL and said to be originated from about 2 km deep from the surface. A diode pumped solid state green laser with power of 25mW and wavelength 532nm was used to excite the fluorescence of the coal sample. The finely powdered sample was made into a very thin pellet and the pellet was kept between two clean glass plates. The optical path of the sample thickness is 1mm.

It is worthwhile to note that the laser light was allowed to be incident on the sample and the fluorescence was observed in the same direction. This arrangement identical with the arrangement of stimulated Raman scattering. An exposure time of about 3 minute was adequate to photograph the fluorescence on a glass photograph using commercially available colour film. The intensity of the fluorescence spectrum was measured with the help of computer software known as Image-J. The fluorescence spectrum is shown below in fig. 1.

Fig.1. Laser induced fluorescence spectrum of a sample of coal (bore hole sample)

3. Results and discussion

The fluorescence spectrum exhibits a broad and diffuse band in the red orange sectors (5900-6500 Å) of the spectrum. This is a very narrow range of spectrum. The spectrum is similar to those reported in an earlier work (Saikia *et.al*, 2007). The only difference is that the laser induced fluorescence spectra of some high sulphur Assam coals the fluorescence spectra were confirmed to a narrow range. The fluorescence spectrum in the red sector of the spectrum is mainly due to the presence of rich vitrinite portions in Assam coals (Saikia *et.al*, 2007). Many authors have also reported the dark red fluorescence band for vitrinite in some coals. The vitrinite and liptinite group analysis of some coals (Saikia *et.al*, 2007) are shown in table 1.

Table 1. Physico-chemical characteristics of some coal samples

Coal	Ash	moisture	Volatile matter	Fixed carbon	sulphur	Vitrinite vol.%
Ledo	10.35	3.07	43.38	43.20	3.57	78.65
Tikak	16.9	2.6	34.9	45.6	2.91	80.31
Tirap	6.6	1.8	45.4	46.2	3.20	79.88
Bargolai	5.7	2.4	47.4	44.5	5.30	78.25

Coals are well known to contain polycyclic aromatic compounds along with aliphatic chains. The red fluorescence may also be due to the aliphatic group CH in the fluorophores. Oxidized coal exhibits red fluorescence, which is due to the presence of aliphatic hydrocarbons.

Pending further work in this field it is reasonable to believe that investigation on laser induced fluorescence of coal is a useful topic with lot of future prospect.

4. Reference

- 1• Meyers R A (1982) Coal structure, Academic Press, New York.
- 2• Baruah R.K, Bhattacharyya G.C, McFarlane U and Baruah G.D. (1995) Radial distribution (x- ray) study of heat treated Assam coal, *Indian J.Pure & Appl Phys*, 34(7), 500-501.
- 3• Saikia B.K, Baruah R.K and Baruah G.D (2007) Laser induced fluorescence spectra of some high sulphur Assam Coals, India, *Energy and Fuels*, 21(6), 3744-3745
- 4• Crelling J.C, Bensley D.F(1995), Recent advances in separating and characterizing single coal macerals: In, Pajares, J.A. and Tascon, J.M.D., eds. Coal Science-proceedings of the Eighth International Conference on Coal Science, Elsevier, Amsterdam, 1, 235-238.